

INTRODUCTION OF F/A-18 PHASED SUPPORT
FOR THE USMC AT MCAS EL TORO

Donald L. Yaney

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THESIS

INTRODUCTION OF F/A-18 PHASED SUPPORT
FOR THE USMC AT MCAS EL TORO

by

Donald L. Yaney

March 1979

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Using the methodology of systems engineering, the thesis develops and recommends a logistic system design approach and an organizational structure to accomplish site optimization of the Site Specific Phased Support Plan.

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FOR THE USMC AT MCAS EL TORO

by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1979

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To achieve and to sustain a high level of aviation fleet readiness with an aircraft and its weapon systems continues to be a major goal associated with every aircraft acquisition program. To date the Navy has not been able to achieve this goal. Some aircraft have enjoyed brief moments of high operational readiness, but no aircraft has enjoyed sustained high operational readiness.

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LIST OF ACRONYMS

AFPRO	Air Force Plant Representative Office
AIMD	Aircraft Intermediate Maintenance Department
APML	Assistant Program Manager for Logistics
AR	Aeronautical Requirement
AVCAL	Aviation Consolidated Allowance List
CETS	Contractor Engineering Technical Services
CG	Commanding General
CLEAR	Closed Loop Evaluation and Reporting System
CMC	Commandant of the Marine Corps
COMCABSWEST	Commander Marine Corps Air Bases West
CPM	Critical Path Method
DoD	Department of Defense
DSARC	Defense Systems Acquisition Review Council
FRS	Fleet Replacement Squadron
GFAE	Government Furnished Aeronautical Equipment
GSE	Ground Support Equipment
H&MS	Headquarters and Maintenance Squadron
ILS	Integrated Logistic Support
ILSMT	Integrated Logistic Support Management Team
IMA	Intermediate Maintenance Activity
LEM	Logistic Element Manager
LORA	Level of Repair Analysis
LSA	Logistic Support Analysis
MAG	Marine Aircraft Group
MAW	Marine Aircraft Wing
McAIR	McDonnell Aircraft Company
MCAS	Marine Corps Air Station
MILCON	Military Construction
3-M	Maintenance, Material Management System
NAMP	Naval Aviation Maintenance Plan
NARF	Naval Air Rework Facility
NAS	Naval Air Station
NAVAIR	Naval Air Systems Command
NATC	Naval Air Test Center
NWC	Naval Weapons Center
PALR	Prediction of Aviation Logistic Requirements
PHST	Packaging, Handling, Storing, Transportation
PMA	Program Manager Aircraft



RILSD	Resident Integrated Logistic Support Detachment
SAIP	Spares Acquisition Integrated with Production
SRA	Shop Replaceable Assembly
SSADP	Support Site Activation Data Package
SSAP	Support Site Activation Plan
SSPSP	Site Specific Phased Support Plan
USMC	United States Marine Corps
WR	Weapons Requirement
WRA	Weapon Replaceable Assembly
WSPD	Weapon Systems Planning Document



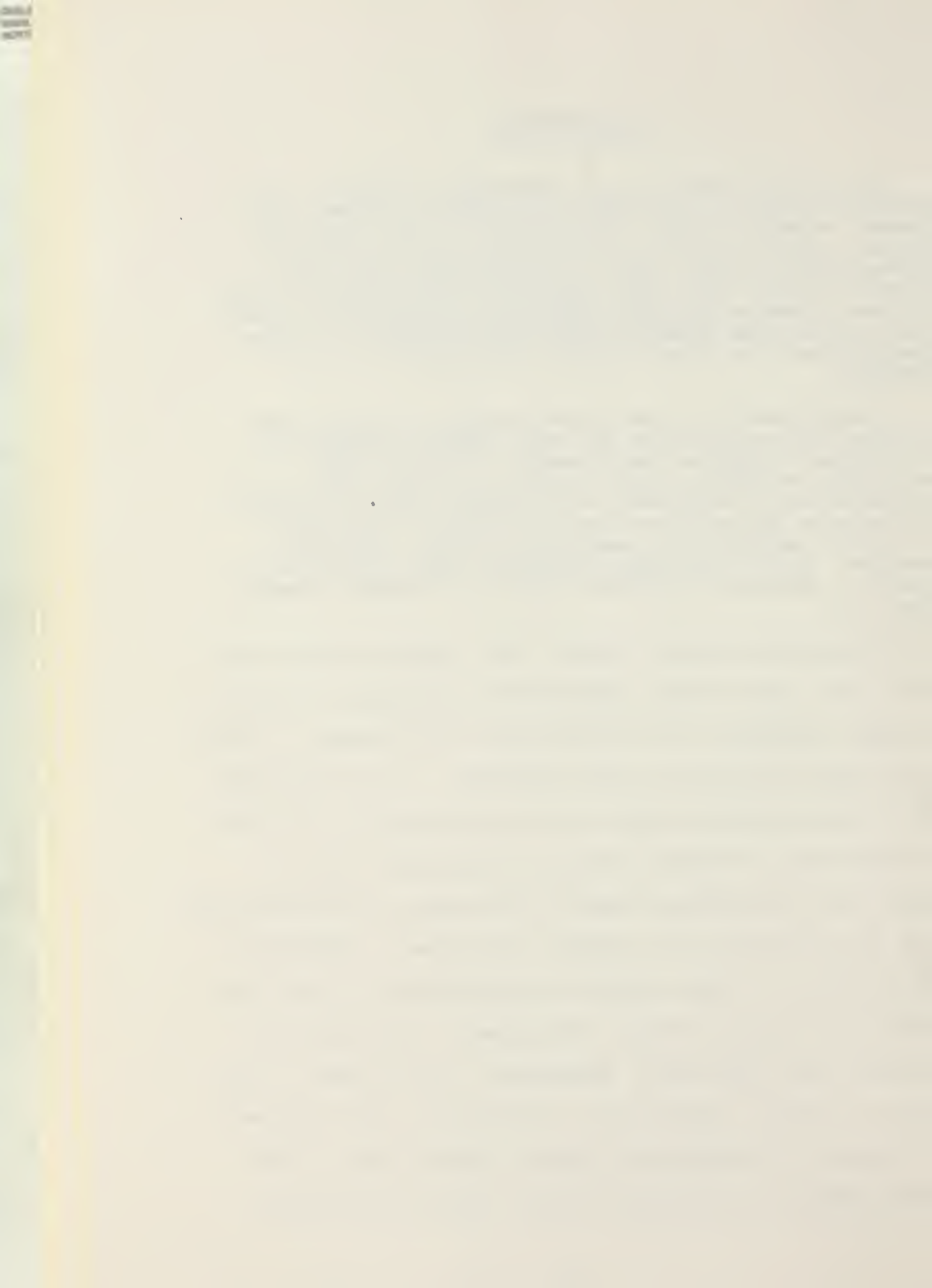
I. INTRODUCTION

"If current trends are a reasonable criterion, major responsibilities of the Naval Air Systems Command will change radically during the remainder of the twentieth century. Naval aviation will in all probability play a substantially larger role in accomplishing the Navy's global mission. With this expanded responsibility, there follows a recognition that the current concept of logistics support must undergo significant change if a sound, adequate level of Fleet aviation readiness is to be achieved.

"Historically, it has proved easier to develop predictions for new missions and new weapons systems than to forecast logistics requirements. This has been a particular personal concern of mine for some time. I am convinced that, consistent with our many other planning initiatives, we must pay more attention to the subject and commit appropriate resources to future logistics demands. To do less simply invites a major difficulty." VADM F.S. Petersen, Commander Naval Air Systems Command /Ref. 1/.

The Integrated Logistic Support (ILS) system concept has evolved as the institutional approach for designing and delivering support systems to the fleet users in an attempt to realize high levels of aviation fleet readiness. "The Integrated Logistic Support System Concept is characterized by: (a) The total integration of logistic design, development, and acquisition with the hardware design, development, and production; and, (b) The integration of logistic resources." NAVMATINST 4000.20A /Ref. 2/.

"This system is characterized as the total integration of logistic design, development, and production. It requires that coordinated, integrated, and systematic planning for the design, acquisition, distribution, and management of the elements of Integrated Logistic Support begin at the conceptual phase or equivalent and that special problems be



identified early in the program." NAVMATINST 4000.20A /Ref. 27.

The ILS concept for the Naval Air Systems Command (NAVAIR), then the Bureau of Naval Weapons, was formalized in 1963 with the promulgation of Weapon Requirement 30 (WR-30), "Integrated Maintenance Management Program Requirements for Aeronautical Systems and Equipments." WR-30, redesignated Aeronautical Requirement 30 (AR-30), was superceded in 1972 by AR-30A, "Integrated Logistic Support Program Requirements for Aeronautical Systems and Equipments," the current NAVAIR requirements document. The provisions of these documents have been included in major NAVAIR hardware acquisition contracts for the past fifteen years.

AR-30A complies with the spirit and intent of Department of Defense (DoD) Directive 4100.35 which defines ILS as "a composite of all the support considerations necessary to assure the effective and economical support of a system for its life cycle ... (and) an integral part of all other aspects of system acquisition and operation ... characterized by harmony and coherence among all the logistic elements." /Ref. 37.

AR-30A requires the preparation of an ILS requirements specification for inclusion in contracts for new aircraft and weapon systems. An ILS detailed specification contains chapters on each of the ILS elements and requires contractor preparation of an ILS Plan. The integrating thread to tie each element together is the Assistant Program Manager for Logistics (APML). Establishment of an Integrated Logistic Support Management Team (ILSMT) is required as the principal management resource of the APML.

The first part of the paper discusses the importance of the research and the objectives of the study. It then proceeds to a literature review, followed by a description of the methodology used. The results of the study are presented in the next section, followed by a discussion of the findings and their implications. The paper concludes with a summary of the main points and a list of references.

The research was conducted in a laboratory setting, using a series of experiments to measure the effects of different factors on the system. The results show that the system is highly sensitive to changes in the input parameters, and that the output is significantly affected by the choice of the input values. The findings suggest that the system can be used to predict the behavior of the system under different conditions, and that it can be used to optimize the system's performance.

The study was limited by the availability of data and the complexity of the system. Further research is needed to explore the system's behavior under different conditions and to develop more accurate models. The results of this study provide a valuable insight into the system's behavior and can be used to inform the design and operation of the system.

The S-3A Aircraft Program introduced the phased support concept in 1972. However, phased support was only applied to the transition of supply support from the contractor to the Navy. The F/A-18 Aircraft Program is applying the phased support concept to the transition of both supply support and maintenance capability from the contractor to the Navy, and is tailoring the phased support to the specific operational sites via the Program innovations of the Site Specific Phased Support Plan (SSPSP) and the Support Site Activation Plan (SSAP).

A. BACKGROUND

Even with all of the aforementioned guidance (methodology and organizational structure), the Navy has not been able to sustain a high degree of aviation fleet readiness with any aircraft and its weapon systems in the operational environment. Each new aircraft acquisition program promises that it will be fleet supportable in the operational environment because "lessons learned" from prior aircraft acquisition programs have been incorporated into the master plan for the new aircraft and its weapon systems.

While "lessons learned" from prior aircraft acquisition programs are interesting, the experience is far too costly both in terms of the lack of aviation fleet readiness and the resulting "get-well" follow-on programs. Therefore, each of the military services, industry, industrial associations, and professional societies are busy in developing means and techniques for implementing ILS. Evolution is the best description of what is happening to ILS as a discipline. Things are

not remaining static.

In an address before the Association of Naval Aviation, Incorporated in April 1978, Vice Admiral Petersen, the Commander, Naval Air Systems Command, announced that he had authorized a study for the Prediction of Aviation Logistic Requirements (PALR). The objective of the study is to develop a realistic scenario to predict logistics demands of Naval Aviation in the 1985 to 1995 time frame. /Ref. 17.

However, existing aircraft acquisition programs cannot wait for future study results. The F/A-18 Aircraft Program is an example of an ongoing aircraft acquisition program where ILS innovations have become routine to the normal conduct of business. The ILS activity was front-end loaded with the assignment of an APML and an ILSMT at the program beginning just after the assignment of the F/A-18 Program Manager (PMA). Hopefully, the front-end loading approach and the ILS innovations will allow the attainment of high operational readiness goals. However, this can only be demonstrated years hence after deployment of operational F/A-18 Aircraft and an analysis of field feedback data.

B. PURPOSE

The primary objectives of this thesis are:

1. To contribute to an improvement in aviation fleet readiness.
2. To show how the systems engineering methodology can be applied to ILS.

The first part of the paper discusses the importance of the study and the objectives of the research. It highlights the need for a comprehensive understanding of the subject matter and the role of the researcher in this process. The second part of the paper presents the methodology used in the study, including the data collection methods and the analysis techniques. The third part of the paper discusses the results of the study and the conclusions drawn from the data. The final part of the paper provides a summary of the findings and suggests areas for further research.

The study was conducted in a systematic and rigorous manner, following the principles of scientific research. The data was collected from a large sample of participants, and the results were analyzed using advanced statistical techniques. The findings of the study are presented in a clear and concise manner, and the conclusions are based on the evidence gathered. The study has important implications for the field and provides valuable insights into the subject matter.

The results of the study show that there is a significant relationship between the variables studied. The findings suggest that the factors identified in the study have a positive impact on the outcome. The study also identifies some limitations and suggests areas for further research. The overall conclusion is that the study has provided a comprehensive understanding of the subject matter and has contributed to the knowledge in the field.

3. To develop a methodology and a recommended organizational structure to promote an effective introduction of phased support of the F/A-18 Aircraft to the U.S. Marine Corps at Marine Corps Air Station, El Toro, California.

C. APPROACH

The method of research consisted of an examination of the F/A-18 Aircraft ILS Program using the systems engineering methodology from both the NAVAIR and the fleet user viewpoints. The research was accomplished by extensive literature reviews, an experience tour in the NAVAIR F/A-18 Aircraft Program Office during the months of August and September, 1978, and attendance at the 4th ILSMT meeting held 6 - 9 November, 1978, at McDonnell Aircraft Company (McAIR), St. Louis, Missouri.

In order to realize the thesis objectives, the F/A-18 ILS Plan, the Master ILS Network, the Tailored Networks, and the development of phased support plans for other activities were analyzed in depth to provide a basis for application to the site activation of the USMC at MCAS El Toro. The author's prior tours of duty in NAVAIR and in the Second Marine Aircraft Wing were helpful in the review of the ILS objectives and site activation.

II. THE F/A-18 AIRCRAFT ILS PROGRAM AND PHASED SUPPORT

A. THE F/A-18 AIRCRAFT ILS PROGRAM

The prime objective of the F/A-18 Aircraft ILS Program is to design, develop, and deliver a logistic support system to the fleet user that will enable the fleet user to achieve and sustain an 85 percent operational readiness rate for the F/A-18 Aircraft in an operational environment.

Figure 1 shows the Naval Air Systems Command (NAVAIR) ILS project organization in support of the above program goal. The traditional ILS elements (maintenance planning, technical data, test and support equipment, facilities, personnel and training, spares and repair parts, and transportation and handling) have been modified to provide a better accommodation of the total NAVAIR organization to the F/A-18 Aircraft Program objectives. /Ref. 47.

A feature of the NAVAIR ILS project organization is the Resident Integrated Logistic Support Detachment (RILSD). The RILSD reports administratively to the Air Force Plant Representative Office (AFPRO) at McAIR's facility and technically to the NAVAIR F/A-18 APML. The primary purpose of the RILSD is to provide continuous on-site technical liaison and recommendations to McAIR, to make recommendations to the F/A-18 APML concerning the Logistic Support Analysis (LSA), and to perform monitoring functions related to the development of an effective logistic support system. /Ref. 57.

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NAVAIR F-18 INTEGRATED LOGISTIC SUPPORT PROJECT ORGANIZATION

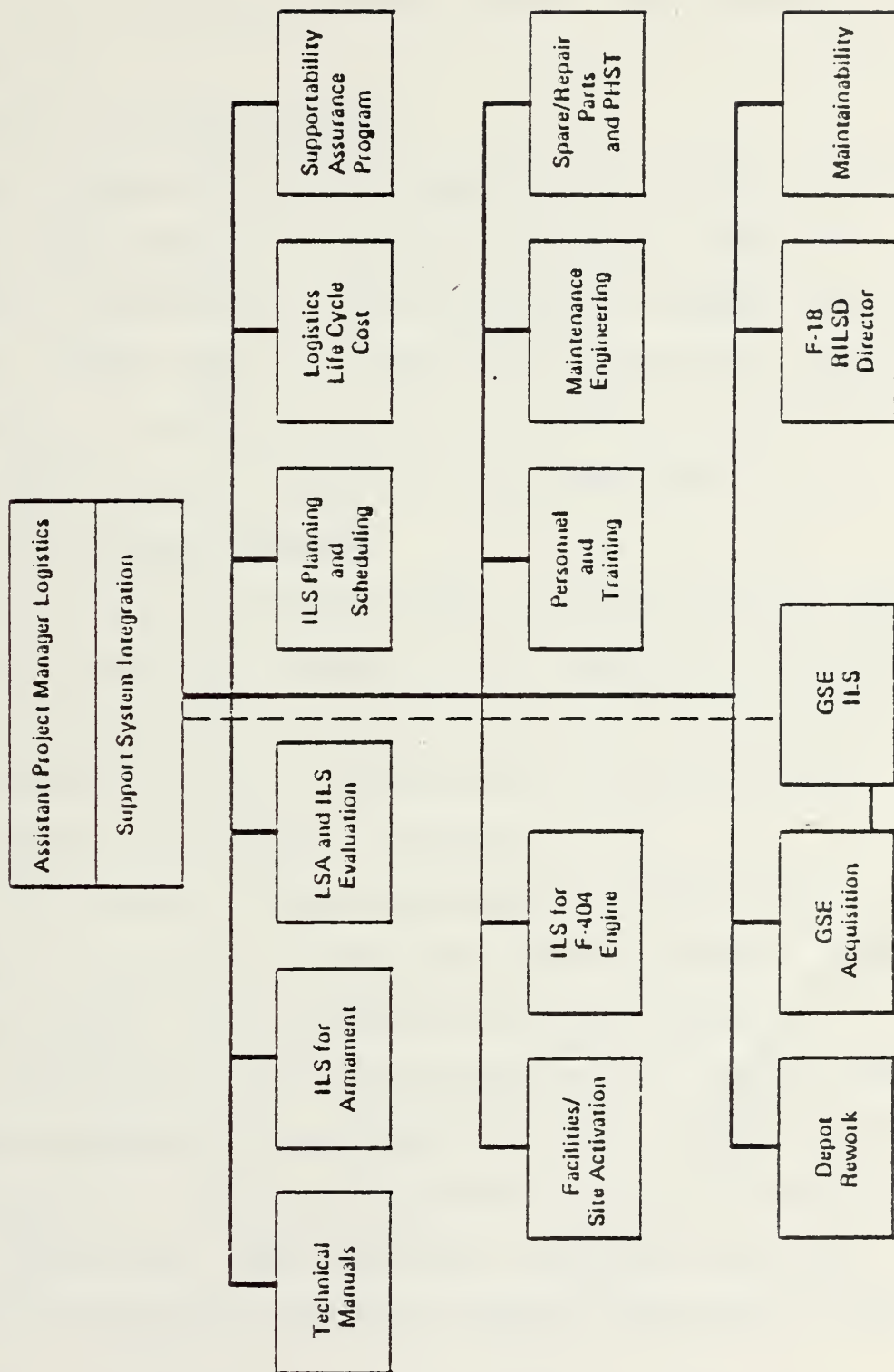


Figure 1

Source: /Ref. 4/

To effectively plan and control the total F/A-18 ILS Program, the critical path method (CPM) technique has been used to design both an ILS Master Network and Tailored Networks. /Refs. 4 and 67.

1. F/A-18 ILS Master Network

The ILS Master Network is based on the Weapons System Planning Document (WSPD) for the F/A-18 Aircraft. The ILS Master Network reflects the interrelationships between individual logistic elements and the scheduling necessary for timely implementation of logistic activities in order to eventually deliver a logistic support system to the fleet user.

2. F/A-18 Tailored Networks

Based on the ILS Master Network, the Tailored Networks were prepared to provide coverage for the hardware functional systems displayed in figure 2. The Tailored Networks are a primary management tool for implementing the phased support concept discussed later in this chapter.

The F/A-18 Aircraft Program represents the first major Navy aircraft acquisition program upon which structured Logistic Support Analysis (LSA) procedures have been imposed. /Ref. 77. "Structured" means that McAIR was required to submit a detailed LSA process proposal using MIL-STD-1388 and related documents only as a base for determining the F/A-18 LSA procedures. In addition, McAIR has been required to establish management controls with vendors to ensure consistency in the LSA process.

Recognizing that the determination of support and resource requirements was dependent on hardware configuration, the F/A-18

F-18 LOGISTICS SUPPORT FUNCTIONAL SYSTEM GROUPINGS

Group A Hydraulic Systems		Group B Airframe		Group C Pneumatic	
System No.	Title	System No.	Title	System No.	Title
02	Hydraulic Power System	18	Fuselage	03	Bleed Air System
15	Landing Gear System (Including Catapult)	19	Wing	07	Air Conditioning System
16	Arresting Gear System	20	Stabilizers (Vertical)		
		22	Doors/Covers		
Group D Life Support		Group E Power Plant		Group F Aircraft Support	
System No.	Title	System No.	Title	System No.	Title
09	Oxygen System	05	Auxiliary Power Unit System	01	Electrical Power System
13	Emergency Equipment	12	Fuel System	08	Ice and Rain Protection System
14	Escape System (Including Canopy)	26	Power Plant	10	Fire Protection System
		27	Power Plant Installation	11	Lighting System
		29	Accessory Drive System	47	General Instruments
				51	Warning and Caution Advisory Systems
Group G Flight Aids		Group H Communication/Navigation		Group I Weapons Systems	
System No.	Title	System No.	Title	System No.	Title
17	Flight Control System	33	VHF Communications	43	Weapon Control System
49	Flight Reference System	34	UHF Communications	44	Weapon Delivery System
50	Flight Control Set	36	IFF System	45	Electronic Countermeasures
		38	Integrated Comm-Nav-IFF Package		
		40	Radio Navigation		
		41	Radar Navigation		
		42	Bomb Navigation		

Source: Ref. 4/.

Figure 2

LSA procedures were designed to bridge the gap between the program ILS and engineering organizations. In accomplishing this task, it was recognized that further refinements could also be made in the manner in which the logistic support system was offered to the specific operational sites. Therefore, the Support Site Activation Plans (SSAP) and the Site Specific Phased Support Plans (SSPSP) were initiated with an intermediate step, the Support Site Activation Data Packages (SSADP) between them and the LSA.

B. F/A-18 PHASED SUPPORT

In order to implement the prime objective of the F/A-18 Aircraft ILS Program, the phased support concept was initiated to organize and manage the acquisition of the logistic support system. Specifically, the phased support concept was initiated to accomplish the following:

"1. The orderly transition of the maintenance capability and material support responsibility from the contractor to the Navy during a multi-year period in which design and support resources are being refined to the mature aircraft configuration.

"2. The alignment of the maintenance plan analysis and resource requirements determination process with the (hardware) design process.

"3. The analytical determination and approval of maintenance (support) requirements prior to the ordering and development of maintenance (support) resources.

"4. The prioritization of the contractor's efforts across the functional aircraft systems based upon expected repair

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 concludes the study and provides recommendations for future
 research.

workload and LCC (Life Cycle Cost) considerations.

"5. The development of fleet interface agreements which provide procedures for contractor use of Navy maintenance facilities at the initial operating sites and for fleet acceptance, certification and management of the transitioning maintenance (support) resources." /Ref. 77.

The phased support concept for the F/A-18 Aircraft ILS Program is based on three assumptions: /Ref. 77.

1. "The transition of the maintenance capability and material support responsibility must be concurrently planned and managed."

2. "The rate of maturity of the weapon system (hardware) design determines when the maintenance plan analysis can be initiated and subsequently, when maintenance (support) resources can be available."

3. "The detail of (hardware) design, which dictates system level maintenance (support) requirements, stabilizes earlier than the (hardware) design detail which dictates component maintenance (support) requirements."

The last assumption provides the basis for incremental completion of the maintenance plan analysis and allows the transition of organizational level maintenance support capability to precede the transition of component support capability at the intermediate and depot maintenance support levels. The aforementioned Tailored Networks provide the control necessary for the phased transition of logistic support capability from the contractor to the Navy.

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The study was conducted in a systematic and rigorous manner, following the principles of scientific research. The data was collected from a large sample of participants, and the results were analyzed using advanced statistical techniques. The findings of the study are presented in a clear and concise manner, and the conclusions are based on the evidence provided.

The study has several limitations, which are discussed in the paper. These limitations include the sample size, the duration of the study, and the potential for bias. Despite these limitations, the study provides valuable insights into the subject matter and contributes to the existing body of knowledge.

The study has several implications for practice and policy. The findings suggest that there is a need for further research in this area, and that the results of the study can be used to inform decision-making. The study also highlights the importance of ongoing research and the need for a collaborative approach to research.

In conclusion, the study provides a comprehensive understanding of the subject matter and contributes to the existing body of knowledge. The findings are based on a large sample of participants and are supported by advanced statistical techniques. The study has several limitations, but the results are valuable and can be used to inform practice and policy.

In order to assure the successful phased transition of the logistic support system, the following supporting activity has been developed:

1. A Naval Air Rework Facility (NARF) North Island, Coronado, California, Logistics Support Team has been established to provide engineering personnel for direct Navy liaison with the contractor at the working level during the maintenance plan analysis time frame. These personnel are assigned to functional (hardware) system groups as shown on figure 2.

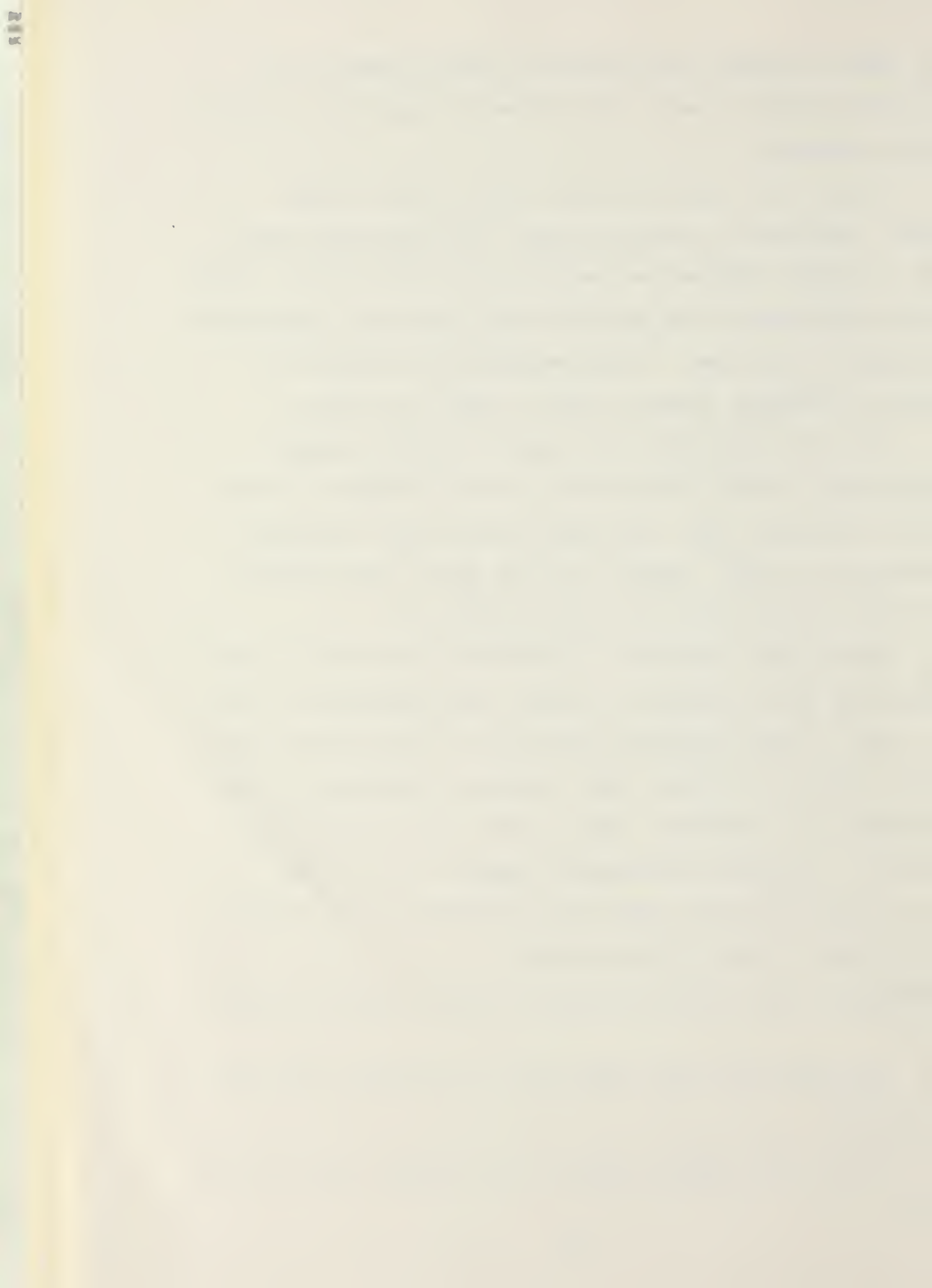
2. Since the contractor has initial material support responsibility and will be providing material support to his aircraft production line, the Spares Acquisition Integrated with Production (SAIP) concept is to be used in the procurement of Navy spares and repair parts. /Ref. 4/

3. An Aircraft Intermediate Maintenance Department (AIMD) agreement has been initiated to define the procedures for contractor use of Navy maintenance facilities at the first training site, Naval Air Station (NAS), Lemoore, California. McAIR is to establish a component repair capability at NAS Lemoore to provide intermediate maintenance support to all fleet operating sites during the transitional process of the logistic support system for the F/A-18 Aircraft.

Embodied in the F/A-18 ILS Program phased support concept are:

1. Management activity conducted on a hardware functional system basis.

2. F/A-18 LSA formally tied to the hardware system design process.



3. Priorities for transitioning hardware functional system components and their required logistic support resources from the contractor to the Navy. Life cycle costs and military worth are considered in each transition transaction.

4. Integrated transition of material support and repair responsibility.

The F/A-18 ILS Program implementation methodology for phased support delivery to the fleet operational sites is the Site Specific Phased Support Plan (SSPSP). This involves managing the transitional process by functional hardware systems and modifying the logistic support system to be compatible to the individual fleet operating sites.

The F/A-18 ILS Program SSPSPs provide operating site personnel with their peculiar logistic support requirements, provide updated logistics information as experience is gained, and are prepared individually for each fleet operational site. The SSPSPs include logistic support concepts for each hardware system and individual hardware components, government furnished equipment logistic support requirements, logistic information required for transition decisions, specific information on each ILS element, and NAVAIR/contractor logistic support responsibilities to the fleet operational site. SSPSPs will aid in transition decision making, ease the complications of logistic support system introduction at new sites, and provide detailed logistics data associated with peculiar support requirements. /Ref. 87.

The companion document to the SSPSP is the Support Site Activation Plan (SSAP). A separate SSAP must be prepared for each designated fleet operational site containing the following information:

1. Site activation management organization.
2. Site activation policies and responsibilities.
3. Contractor personnel loading required to support the site activation.
4. Detailed activation schedules.
5. Facilities and equipment requirements recommendations.
6. Equipment installation drawings and instructions.
7. Support equipment installation check-out contracts.
8. Acceptance procedures and forms for installed equipments.

C. F/A-18 ILS PROGRAM AND PHASED SUPPORT SUMMARY

Among the innovative actions instituted by the F/A-18 Aircraft Program to realize high operational readiness with the aircraft and its weapon systems in the environment of the fleet user has been the incorporation of the phased support concept with the F/A-18 Program innovations of the Site Specific Phased Support Plans and Support Site Activation Plans.



III. SYSTEMS ENGINEERING METHODOLOGY

Because systems engineering methodology was so important in the development of the F/A-18 Aircraft ILS Program and is central to the development of this thesis, the basic logic of the methodology as it was developed by Kline is presented.

/Ref. 97.

A. SYSTEM LIFE CYCLE

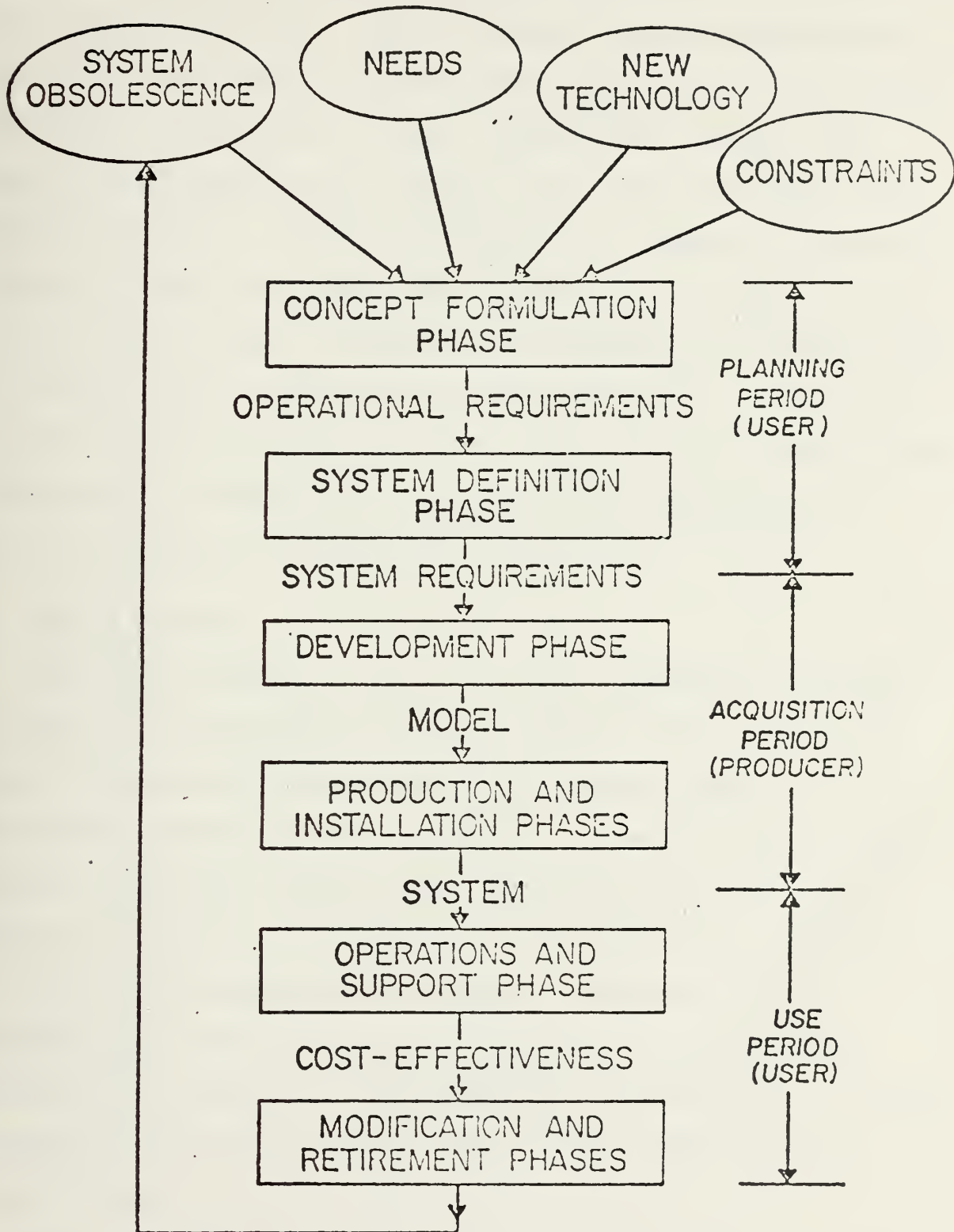
The system life cycle can be viewed as a set of activities which are of concern to the users of the system and to the producers of the system. The user is concerned with developing the needs and concepts for the system and for the operation and support for the system. The producer is concerned with translating the user's needs into the design, production, and installation of the system. Thus, a user-producer dialogue is a very important part of the system life cycle.

In the military, there is both an internal user-producer dialogue and an external user-producer dialogue. In the case of the F/A-18 Aircraft Program, the external user-producer dialogue is represented by the NAVAIR Program Office as the user and McDonnell Aircraft Company (McAIR) as the producer. The internal user-producer dialogue is represented by the fleet operational sites as the users and the NAVAIR F/A-18 Aircraft Program Office as the producer.

The system life cycle, figure 3, is made up of three periods: planning, acquisition, and use. Each period contains



SYSTEM LIFE CYCLE



Source: /Ref. 97.

Figure 3



phases. Concept formulation and system definition are within the planning period. Development and production are within the acquisition period. Operations and support, modification, and finally retirement are within the use period. The development phase contains five stages: preliminary design, engineering development, detail design, test and evaluation, and production design. Systems engineering is primarily concerned with the system life cycle from the beginning through the production design stage. In-service engineering is concerned with the system from the completion of the production design stage through the end of the life cycle. This thesis is concentrated in the area of transition from systems engineering to in-service engineering in the system life cycle.

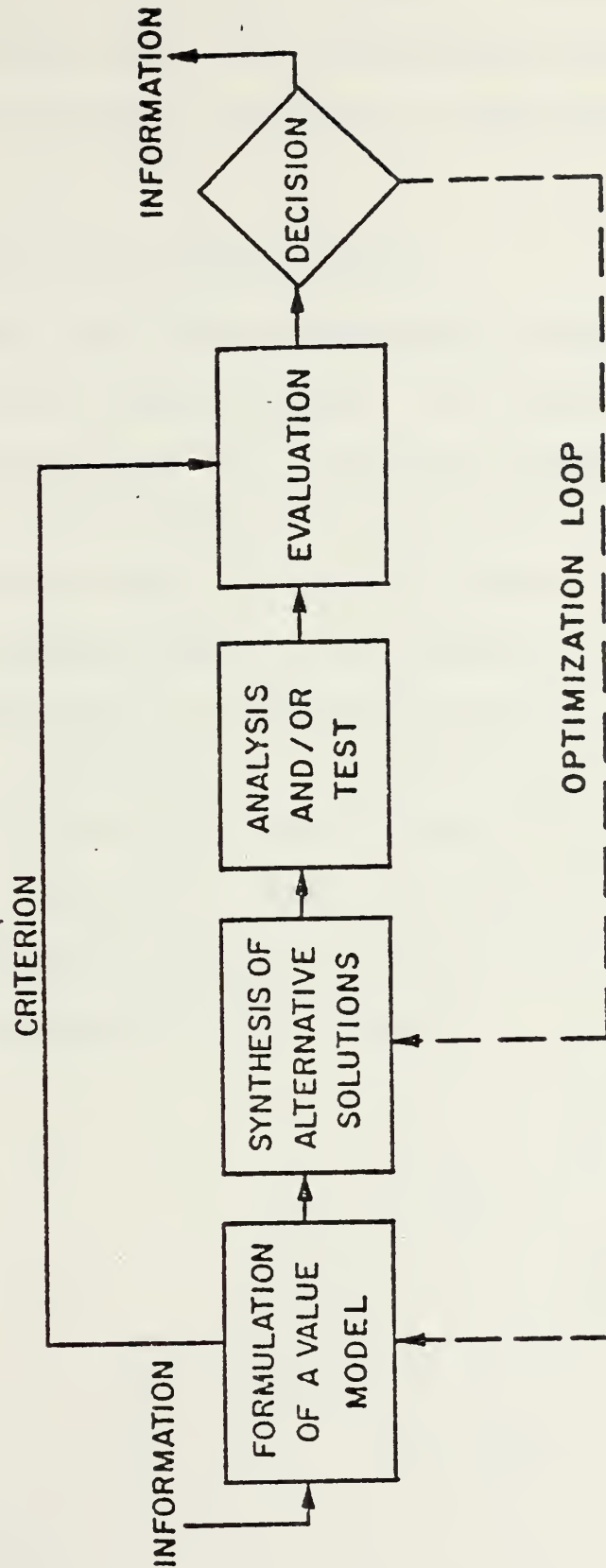
B. DESIGN PROCESS

The design process, figure 4, is the fundamental sequence of activities occurring during each stage of the system life cycle. The information generated by repeated application of the design process reduces uncertainty concerning the desired system. During the planning and acquisition periods of the system life cycle, it is concerned with optimizing a system for anticipated operating conditions, production and use respectively. During the use period, it is concerned with optimizing the operation and support of a given system. It is fundamental that both the user and producer understand the design process.

While all activities of the design process are important, the optimization feedback loop is of primary importance to the

A MODEL OF THE SYSTEM DESIGN PROCESS

(THE HORIZONTAL STRUCTURE OF SYSTEMS ENGINEERING)



Source: Ref. 97.

Figure 4



successful application of the design process. The optimization feedback loop permits the use of the information produced by the design process to guide the synthesis of additional alternative solutions.

C. SYSTEM LIFE CYCLE/DESIGN PROCESS MATRIX

Figure 5 represents the matrix relationship between the system life cycle and the design process. The system life cycle is displayed vertically; and, the design process is displayed horizonatally. The system life cycle and the design process are iterative as shown in figures 3 and 4.

The systems engineering approach, as displayed in figure 5, is the basis for synthesis of a methodology and an organizational structure to accommodate the implementation of phased support of the F/A-18 Aircraft at MCAS El Toro. It provides the methodology and structure to facilitate the user-producer dialogue between NAVAIR and the USMC at MCAS El Toro necessary for designing and implementing phased support.

IV. SYNTHESIS, ANALYSIS, AND EVALUATION

A. INTRODUCTION

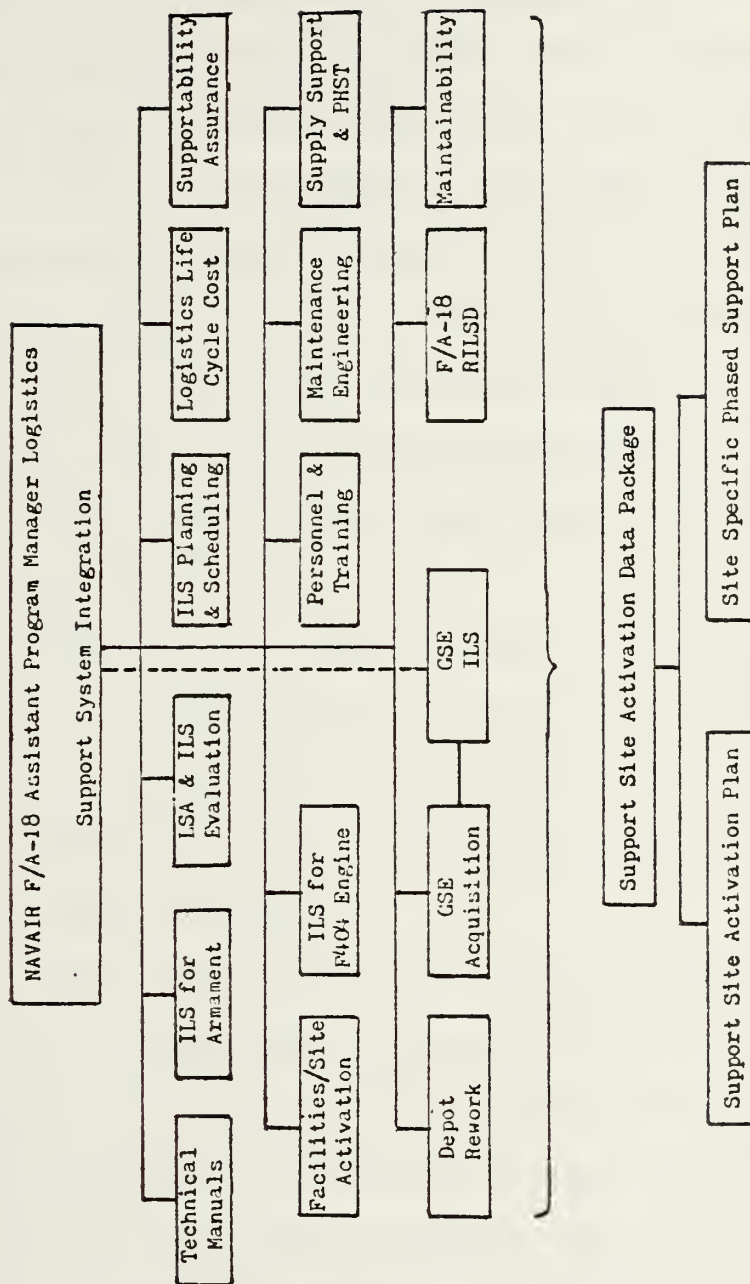
The concept of phased support and the F/A-18 Aircraft Program's innovation of the Site Specific Phased Support Plans (SSPSP) offer promise toward the realization of high operational readiness. However, those skilled in systems engineering practices know that it is possible to move only so far down in a top-down approach to system design. It then becomes necessary to approach the design from the bottom up to have a common meeting ground in order to achieve an optimal system design compatible with the operational environment and the specific site. The top-down approach provides the criteria and allocations to lower system levels for design optimization. This same approach is applicable to the design of the logistic support system.

B. BACKGROUND INFORMATION

Figure 6 shows the Naval Air Systems Command (NAVAIR) F/A-18 ILS organization and the products which will be delivered to the U.S. Marine Corps at Marine Corps Air Station (MCAS) El Toro, California. The USMC at MCAS El Toro was selected for illustration because it represents the first operational site activation for the F/A-18 Aircraft. Figure 6 illustrates that the NAVAIR Assistant Program Manager for Logistics (APML) acts as the support system integrator with the Logistic Element Managers (LEM) in order to produce a



NAVAIR F/A-18 ILS ORGANIZATION AND THE SITE PRODUCTS



Source: Ref. 4/.

Figure 6

Support Site Activation Data Package (SSADP) from which he and the LEMs will derive and deliver to the USMC at MCAS El Toro the Site Specific Phased Support Plan (SSPSP) and its companion document, the Support Site Activation Plan (SSAP).

Figure 7 represents excerpts from the F/A-18 Aircraft Program Master ILS Network displaying the major events leading up to the delivery of the SSAP and SSPSP to the USMC at MCAS El Toro. Both documents are derived from the LSA and the SSADP, and follow parallel paths to the site activation scheduled to occur in January 1983. Obviously, there are many more events in the total network, but figure 7 is representative of the detail of planning that has already taken place in the NAVAIR F/A-18 Aircraft Program.

Although the SSPSP for the USMC at MCAS El Toro has not yet been produced, it is expected to be similar in nature to the Final SSPSP for the Naval Air Test Center (NATC) Patuxent River, Maryland. [Ref. 10]. The table of contents of that document is reproduced as table 1.

In addition to the test site activation at NATC Patuxent River, there will have been test site activations at Naval Air Station (NAS) Point Mugu, California, and Naval Weapons Center (NWC) China Lake, California, as well as a training site activation of the Fleet Readiness Squadron (FRS) at NAS Lemoore, California, prior to the site activation at MCAS El Toro. The data and experience gained at these site activations should be valuable in the preparation of the SSPSP for the USMC at MCAS El Toro. The F/A-18 Aircraft Program Closed Loop

Table 1

SITE-SPECIFIC PHASED SUPPORT PLAN
FOR NAVAL AIR TEST CENTER, PATUXENT RIVER, MARYLAND, FINAL

<u>CHAPTER</u>	<u>TABLE OF CONTENTS (OPEVAL II PROGRAM SUPPORT)</u>	<u>PAGE</u>
1.0	INTRODUCTION	II 1-2
2.0	SITE FUNCTIONS	II 2-1
3.0	SCHEDULE OF OPEVAL II EVENTS	II 3-1
4.0	MAINTENANCE SUMMARY	II 4-1
5.0	SPARES/REPAIR PARTS	II 5-1
6.0	GROUND SUPPORT EQUIPMENT	II 6-1
7.0	PACKING-HANDLING-SHIPPING-TRANSPORTATION	II 7-1
8.0	MATERIAL CONTROL	II 8-1
9.0	FACILITIES	II 9-1
10.0	TECHNICAL MANUALS	II 10-1
11.0	TRAINING	II 11-1
12.0	REPAIR-MODIFICATION-OVERHAUL	II 12-1
13.0	DATA COLLECTION	II 13-1
14.0	TRANSITION TO NAVY SUPPORT	II 14-1
APPENDIX A	GFAE LOGISTIC SUPPORT PLANS	A-1
APPENDIX B	LIST OF WRA'S FAULT ISOLATED ON HOT MOCK-UP	B-1
APPENDIX C	ACRONYMS	C-1

Source: Ref. 10.



EXCERPT FROM NAVAIR F/A-18 MASTER ILS NETWORK

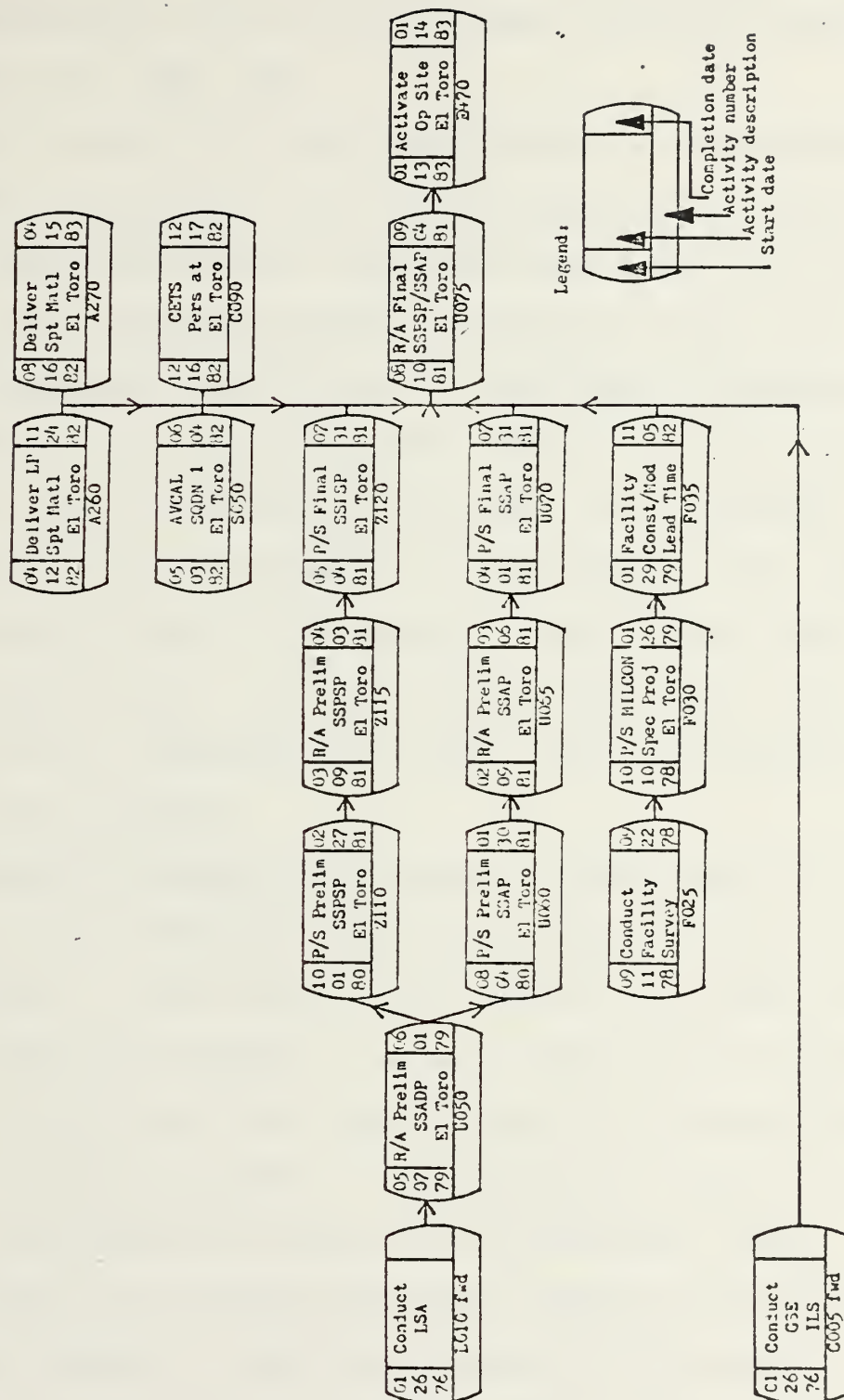


Figure 7

Source: Ref. 47.

Evaluation and Reporting (CLEAR) System [Ref. 47] data on which so much of the early logistic system design was based will have been supplemented by the Navy Maintenance, Material Management (3-M) System data [Ref. 117].

Figure 8 presents the basic organization of the USMC at MCAS El Toro. While there are similarities to the organization of a Naval Air Station, there are some significant differences. The Commanding General of the base "wears two hats"; he is the Commander Marine Corps Air Bases West (COMCABSWEST) and the MCAS El Toro base Commander. He is not in the chain of command of the Fleet Marine Force, but, as COMCABSWEST, he reports directly to the Commandant of the Marine Corps (CMC). He is considered to be in the support forces rather than in the operational forces. He has a supply department, but he does not have any intermediate or depot level maintenance capability for aircraft.

The Commanding General, 3rd Marine Aircraft Wing (3rd MAW) is an operational commander reporting directly to the Commanding General, Fleet Marine Force, Pacific. He does not report to the base Commander. He is a tenant only of the base Commander's real estate and obtains some of his logistic support from the base Commander. The Commanding General's, 3rd MAW immediate operation is that of an operational staff. Marine Aircraft Group (MAG) Commanders report to the Commanding General, 3rd MAW. MAGs are composed of both support squadrons and operational squadrons. Those of primary concern to this thesis are the Headquarters and Maintenance Squadron (H&MS) and the aircraft operational squadrons. The H&MS

USMC at MCAS EL TORO

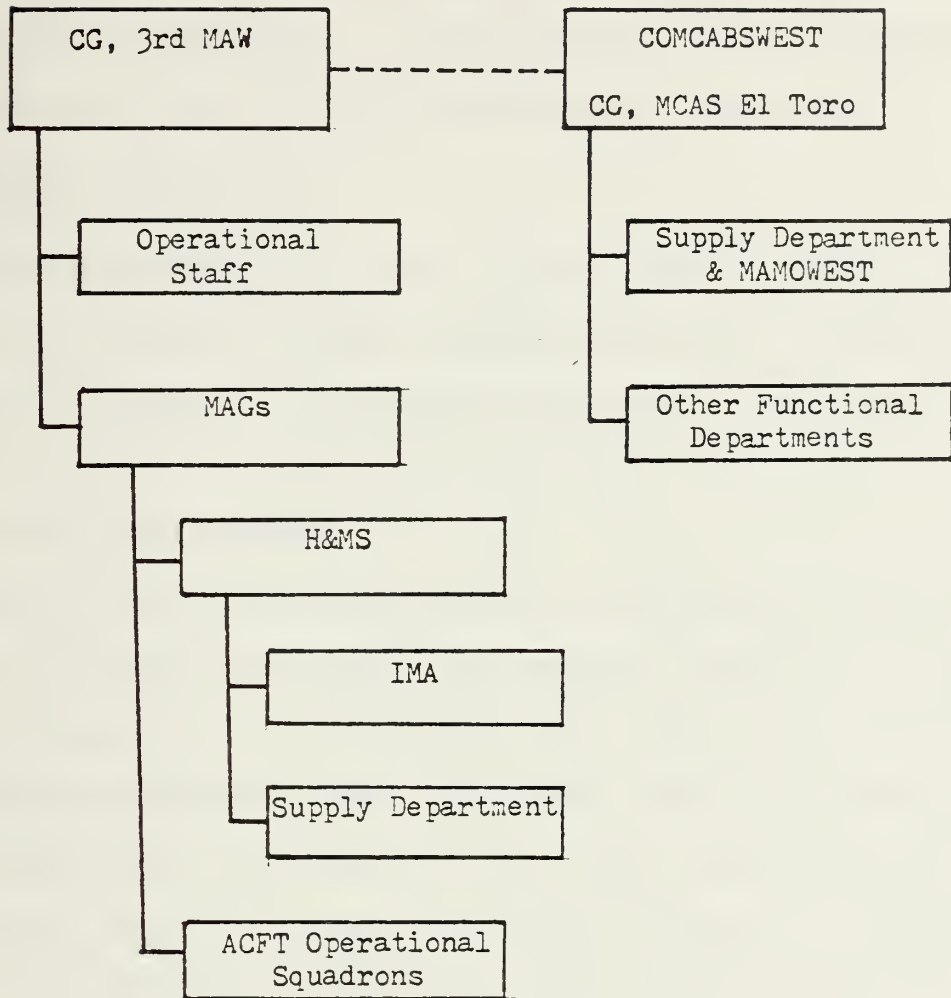


figure 8



contains both an Intermediate Maintenance Activity (IMA) and a supply department with an Aviation Consolidated Allowance List (AVCAL) of material. Organizational level maintenance is performed in the aircraft operational squadrons.

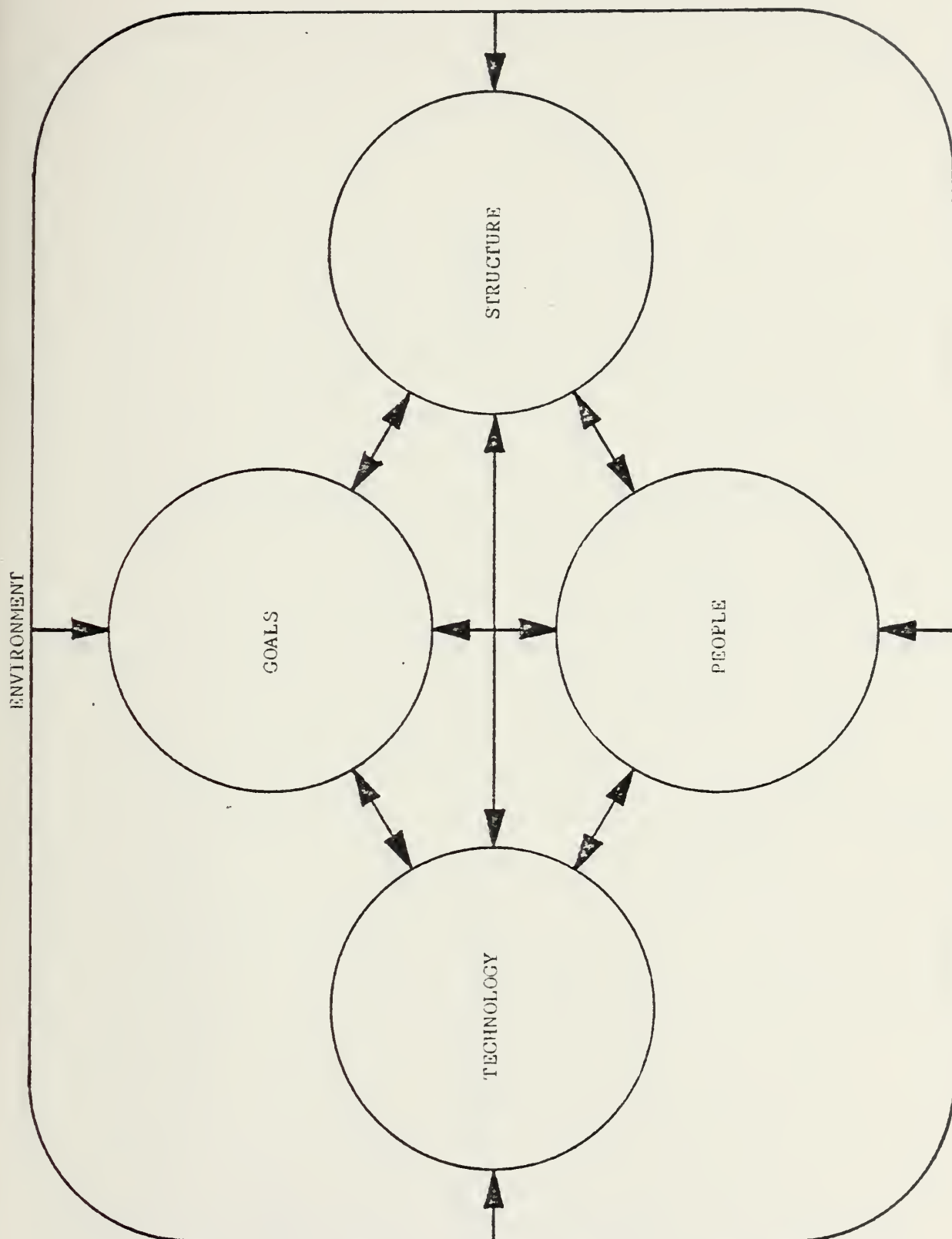
C. PROBLEM DEFINITION

From the beginning of the F/A-18 Aircraft Program, the goal of the logistic support system has been to achieve and to sustain a minimum of 85 percent operational readiness for the aircraft system throughout its operating life cycle in the operational environment.

Figure 9 is a conceptual model developed by Leavitt [Refs. 12 and 13] that can be used for defining problems of structures and organizations. It indicates that there are relationships and interdependencies among the goals, structure, people, technology, and environment of any given organizational situation. Figure 10 shows the model tailored to the MCAS El Toro F/A-18 logistics situation. The people element has been expanded to include all resources, and the technology element has been more specifically defined to mean logistics technology.

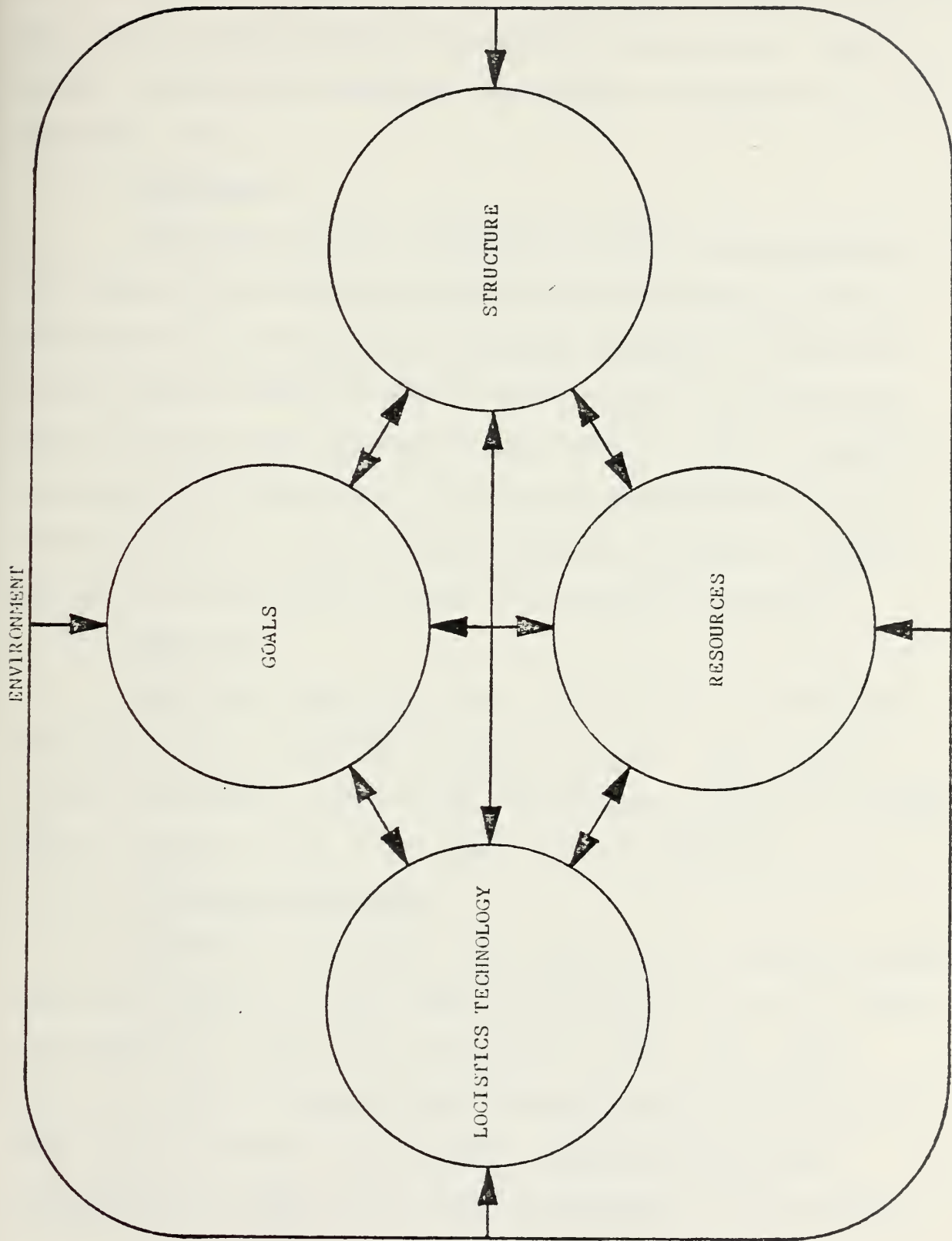
1. Goals

The F/A-18 Aircraft Program goal of achieving and sustaining a minimum of 85 percent operational readiness for the aircraft and its weapon system through deployment is a primary effectiveness measure. However, the operational readiness goal is not the only value measure. The logistic support system must also be resource consumption efficient and schedule



Source: /Ref. 12/.

Figure 9



Source: /Ref. 12/.

Figure 10

effective. Schedule may be viewed in two parts: (1) that which relates to meeting the F/A-18 Aircraft Program milestones, and (2) that which relates to enabling the aircraft (and its weapon systems) to accomplish its mission throughout its operational life.

2. Structure

Structure implies form which implies an organization. The NAVAIR F/A-18 Aircraft Program ILS structure is the organization to accomplish the top-down approach to logistics design, and the USMC at MCAS El Toro is the organization to receive and use the product of that effort. What is needed is a structure to facilitate coordination and communication between them and to foster a user-producer dialogue to produce the SSAP and the SSPSP in order to optimize the goals.

3. Resources

Resources refer to those of the F/A-18 Aircraft Program and those of the USMC at MCAS El Toro. They include; dollars, personnel, facilities, consumables, spares and repair parts, technical data, and ground support equipment.

4. Logistics Technology

Logistics technology with regard to the specific problem being studied in this thesis include such items as models (provisioning, inventory) and analysis tools (LSA, LORA) which are used to produce such documents as the SSADP, the SSAP, and the SSPSP. Additionally, systems engineering methodology provides the logical development of the products.

5. Environment

For the purpose of this thesis, the environment of concern is the operational support environment. It includes organizational elements such as the NAVAIR F/A-18 Aircraft Program and the USMC at MCAS El Toro. It also includes policy (the Naval Aviation Maintenance Plan, the Federal Supply System), operational (flying hour programs, flight schedules, deployments), and economic environments (budgets, costs, personnel, resources). The environment represents constraints.

In summary, the definition of the problem is to optimize the F/A-18 logistic system effectiveness (operational readiness and schedule goals) and resource economy, facilitated by an efficient organizational structure utilizing applicable logistics technology, subject to the various environmental constraints.

D. PLAN FOR PROBLEM SOLUTION

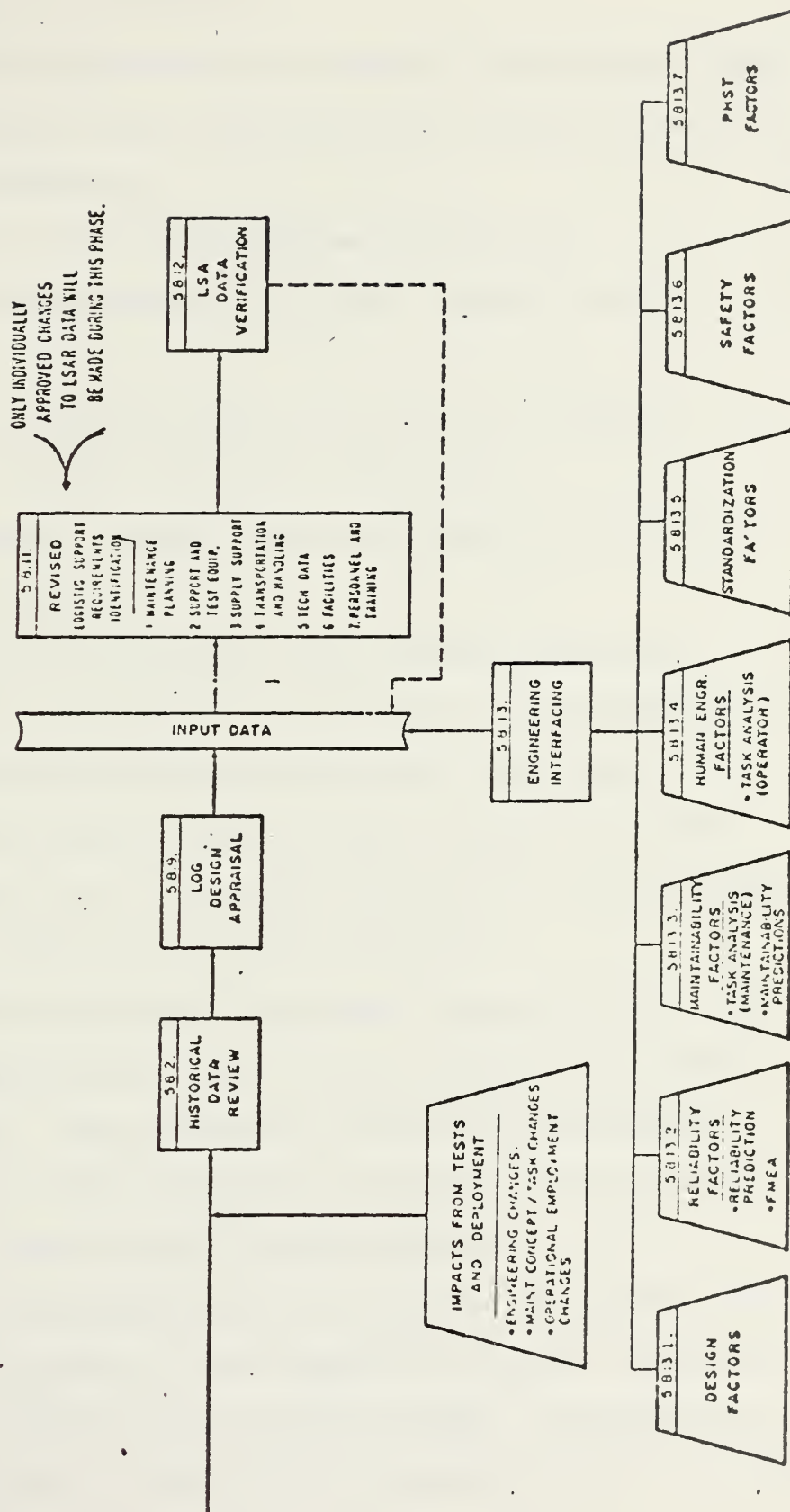
The environment and the goals are fixed. Resources everywhere are scarce. Therefore, the plan for the problem solution lies in the application of logistics technology and organizational structure.

1. Application of Logistics Technology

a. Logistic Support Analysis (LSA)

The basic philosophy and logic for the SSPSP comes from the Logistic Support Analysis (LSA). LSA is the subject of MIL-STD-1388. /Ref. 14/. Figure 11 is a reproduction of the Production/Deployment Phase flow diagram from MIL-STD-1388-1 following Defense Systems Acquisition Review Council

PRODUCTION / DEPLOYMENT PHASE



Source: /Ref. 14/.

Figure 11

(DSARC) Milestone III. There are several difficulties with the logic displayed in figure 11:

(1) It is essentially a repeat of the prior phases with no distinction of the transition from systems engineering to in-service engineering.

(2) It contains no problem definition.

(3) It represents a top-down logistics design approach only.

(4) It does not follow the logic of figure 4.

b. The Situation upon Site Activation

The basic scenario upon site activation of the USMC at MCAS El Toro is:

(1) This will be the first operational site.

(2) The aircraft will have been through several test site activations and one training site activation.

(3) Some functional hardware systems will have matured sufficiently for transition of logistic support responsibility to the USMC/Navy from the contractor.

(4) The aircraft operational squadrons under the MAG will be responsible for most of the organizational level maintenance effort. The contractor will be responsible for the organizational level maintenance effort on those systems/sub-systems that have not been transitioned.

(5) Intermediate level maintenance responsibility will be vested initially at NAS Lemoore in a joint contractor/Navy Intermediate Maintenance Activity (IMA). Capability and capacity of the H&MS will be built up gradually as the systems/sub-systems mature.

(6) There will be an SSPSP and its companion document, the SSAP.

Within this basic scenario, what are the opportunities to be realized by the USMC at MCAS El Toro? In some ways the converse of that question is easier to answer by stating prior weapons system problems as they are related to the inadequacies of support systems:

"A. One or more of the individual elements of logistics is incompatible with the prime equipment (e.g., the prescribed test and support equipment will not perform the proper functions in verifying prime equipment operation or in the performance of maintenance).

"B. The depth and extent of support provided is insufficient (e.g., there are not enough of the required type of spares available; the personnel assigned to operate and maintain the equipment are inadequately trained for the job; etc.).

"C. The level of support in certain areas is higher than what is actually required (e.g., facilities, personnel, and support equipment are not being fully utilized or there are too many spare parts of a certain type which results in a higher inventory cost than necessary).

"D. The elements of logistic support are incompatible with each other (e.g., the maintenance procedures do not cover the tasks being performed at a given echelon and the support equipment used in task accomplishment)." Blanchard /Ref. 157.

c. The Design Process applied to the SSPSP

Although the F/A-18 Site Specific Phased Support Plans (SSPSP) represent a greater level of detail in the logistics design process than has been attempted before in the acquisition of major aircraft, it still represents primarily a top-down approach to logistics design accomplished essentially by a team of McDonnell Aircraft Company (McAIR) and NAVAIR personnel. Figure 3, the system life cycle model, has been faithfully followed by these personnel in the design of the logistic support system from the beginning into the production design stage (systems engineering effort). However, to effect the transition from systems engineering to in-service engineering, the logistics design process still requires the application of the bottom-up approach including involvement with the specific fleet user in order to assure that operational readiness goals are achieved.

Generally, the specific fleet user has not normally been directly involved as part of the user-producer dialogue in the logistics design process, particularly at the point of transition from systems engineering to in-service engineering in the system life cycle. This past omission may have contributed significantly to the lack of acceptable levels of operational readiness in prior aircraft systems. Hopefully, applying the system life cycle and system design process approach will allow the attainment of optimal operational readiness goals. However, this can only be demonstrated years hence with the deployment of operational F/A-18 Aircraft and an analysis of the resulting field feedback data.

By applying the design process and MIL-STD-1388 to the preliminary SSAP, the preliminary SSPSP, and the problem of site activation at MCAS El Toro, the model takes on the form of figure 12. Figure 12 is a logical application of logistics technology because:

(1) It has a logical beginning and end.

(2) The input information provides for the inclusion of all applicable knowledge and experience, and a bottom-up logistic design conduit is provided to complement the top-down approach from NAVAIR.

(3) There is a goal and problem definition including:

(a) Definition of criteria on which to evaluate and optimize.

(b) Definition of what to synthesize, analyze, and evaluate in order to reach an optimal decision.

(4) The optimal decision is obtained.

(5) The output products are an optimal SSAP and an optimal SSPSP.

2. Organizational Structure

A structure is required to operate the model shown in figure 12, and to facilitate coordination and communication between the NAVAIR F/A-18 Program and the USMC at MCAS El Toro in order to optimize the SSAP and the SSPSP. By combining figures 6 and 8 and adding a USMC Site Logistics Project organization in a matrix fashion, the organizational structure takes the form displayed in figure 13.

LOGISTIC SYSTEM DESIGN MODEL

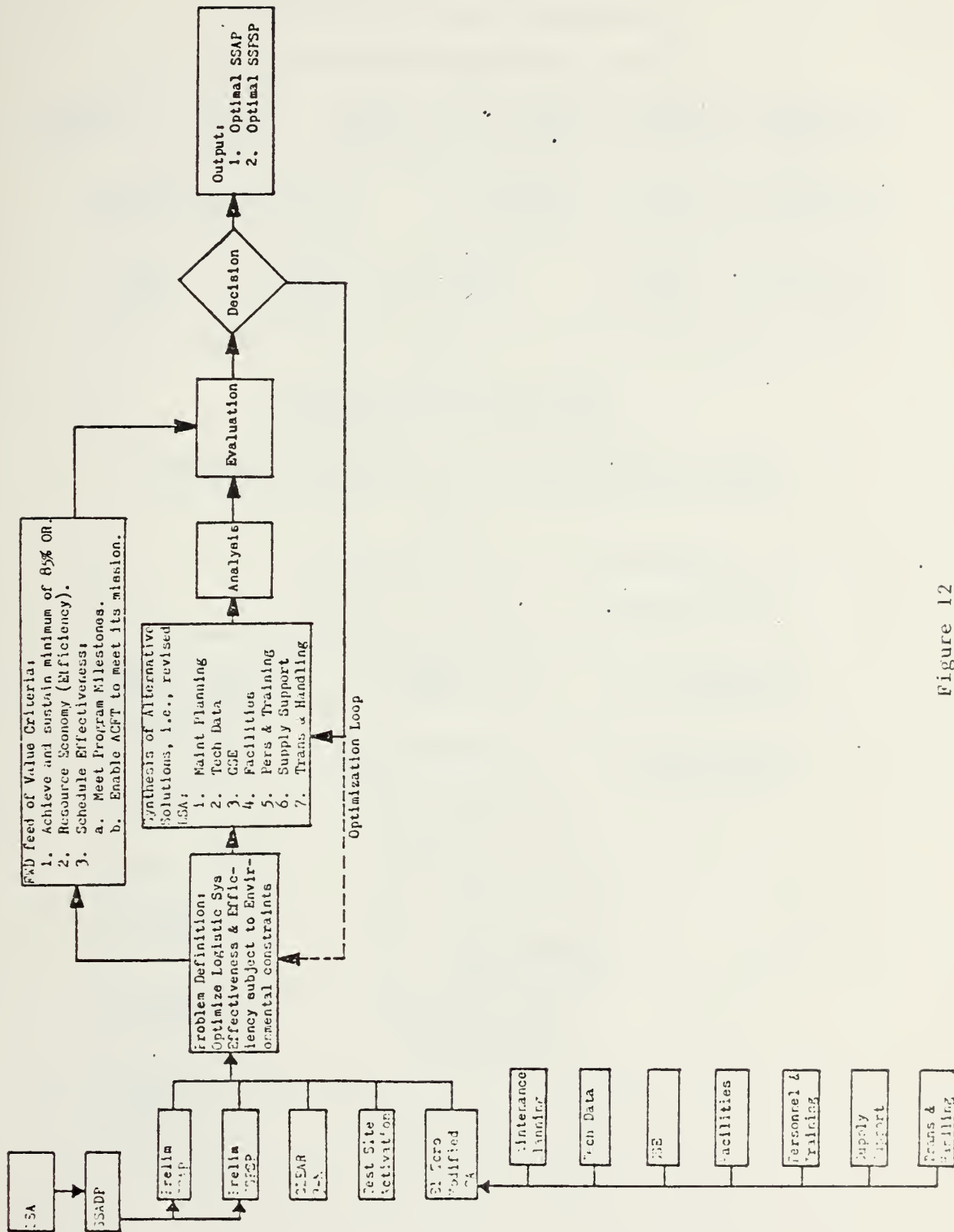


Figure 12

ORGANIZATIONAL STRUCTURE FOR BOTTOM-UP DESIGN APPROACH

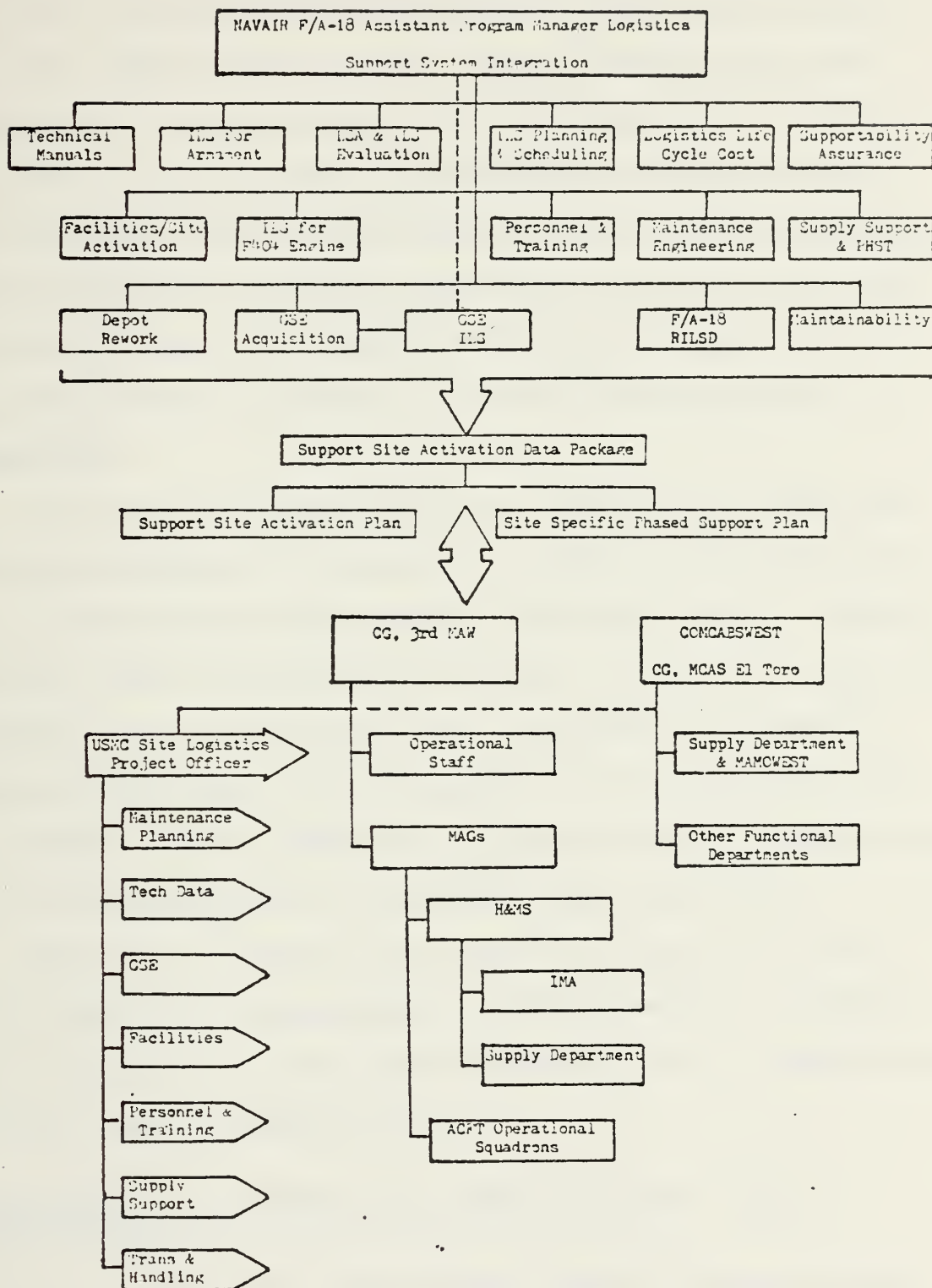


Figure 13

Figure 13 down to the two-way arrow shows the NAVAIR F/A-18 ILS organization and the products which will be delivered to the USMC at MCAS El Toro. This represents the top-down logistics design approach. The organizational structure of the USMC at MCAS El Toro is shown below the two-way arrow as the functional part of the matrix. The USMC Site Logistics Project organization completes the matrix by going across the functional entities. The USMC Site Logistics Project and the matrix organization is the key to the bottom-up logistic design approach.

In fact, the NAVAIR F/A-18 ILS organization displayed at the top of figure 13 is actually a matrix organization when viewed in conjunction with NAVAIR's functional codes. NAVAIR's functional codes are omitted for clarity. Therefore, there is an organizational match between the two halves of figure 13. The major difference is that the NAVAIR LEM descriptions have been expanded, and the USMC Site Logistics Project LEM descriptions are representative of the traditional LEM titles.

The two-way arrow in the center of figure 13 is the key to a productive user-producer dialogue wherein an optimal logistic design may evolve compatible with both the operational environment and the specific site.

E. IMPLEMENTATION APPROACH FOR PROBLEM SOLUTION PLAN, MODIFIED LSA

Figure 12 contains a block labeled "MCAS El Toro Modified LSA" with site LEM activities feeding into it. If the F/A-18 Aircraft Program can structure the LSA process, as explained

in chapter II of this thesis, the implication is that the USMC at MCAS El Toro can modify the LSA process in order to perform a bottom-up approach to an optimal site logistic support system design.

The NAVAIR F/A-18 ILS Program, the top-down approach, provides the criteria and allocations via the preliminary SSAP and preliminary SSPSP to the USMC Site Logistics Project Office at MCAS El Toro for logistic support system design optimization. Figure 12 provides the logic for the accomplishment of the modified LSA by the USMC Site Logistics Project Office at MCAS El Toro.

It is emphasized that the modified LSA to be initiated by the USMC Site Logistics Project Office at MCAS El Toro is not the typical "review and approve" action of one command's plan by another command. Certainly, an evaluation of the NAVAIR preliminary SSAP and preliminary SSPSP is in order, but they represent only one alternative among several to be synthesized, analyzed, and evaluated. Blanchard offers the following advice for performing evaluation:

"When evaluating a typical system or equipment, it is necessary to consider operational requirements, the maintenance concept, design features, production/construction plans, anticipated logistic support, etc. For instance, if the analyst wishes to compare alternative design approaches, each proposed configuration must be projected in terms of a planned operational posture. In addition, an assumed maintenance concept and an estimate of anticipated logistic support requirements

are necessary in order to accomplish the evaluation on a life cycle basis. On the other hand, the analyst may wish to evaluate alternative operational concepts. This requires an assumed maintenance concept, design configuration, and logistic support policy. In other words, the analysis is an iterative process involving the evaluation of different elements of the system in terms of the whole, keeping certain features constant while varying others, and so on. The objective is to accomplish the analysis keeping in mind the interface relationship between logistic support and the prime system/equipment configuration." Blanchard /Ref. 157.

Now is not too early to start. Just as the success to date of the NAVAIR F/A-18 ILS Program was due in part to front-end loading of the ILS effort, the bottom-up logistic design approach can also be initiated by the USMC at MCAS El Toro. The NAVAIR F/A-18 ILS Program Master Network and the Tailored Networks serve as basic control devices in timing the actions initiated by the USMC Site Logistics Project Office.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. The NAVAIR F/A-18 Aircraft Program has already generated a significant effort towards the ILS goal of enabling the aircraft and its weapon systems to achieve and to sustain a high level of aviation fleet readiness.

2. The system design approach using the methodology of systems engineering provides the logic for logistic support decision making with both user and producer participation.

3. The utilization of a bottom-up design approach by the USMC at MCAS El Toro in order to optimize the F/A-18 site logistic support system should help provide assurance that the goal will be achieved.

4. While only the F/A-18 Aircraft Program and the site activation of the USMC at MCAS El Toro is addressed in this thesis, the methodology is applicable to any aircraft acquisition program and to any site activation at that transitional stage in the system life cycle where systems engineering becomes in-service engineering.

B. RECOMMENDATIONS

1. Form a USMC Site Logistics Project Office using the recommended matrix organization at MCAS El Toro from the personnel assets of the CG, MCAS El Toro and the CG, 3rd Marine Aircraft Wing.

2. Initiate the bottom-up design approach to achieve an optimal F/A-18 site logistic support system for the USMC at MCAS El Toro.

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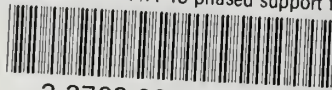
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